

- Fig. 4. *Alligator mississippiensis*, *juv.* of 112 centim. total length. Floor of olfactory chamber, as seen from above, after the removal of the olfactory mucous membrane and the underlying cartilaginous floor of the olfactory capsule. (A portion of the latter, which was left in position, is indicated at *ns.f.*) *Nat. size.*
- Fig. 5. *Caiman niger*. Comparison dissection to fig. 4; dried skull only. *One-third nat. size.*
- Fig. 6. *Alligator mississippiensis*, *juv.* Premaxillo-maxillary suture with parts adjacent, ventral aspect. *Three times nat. size.*
- Fig. 7. *Caiman niger*. Premaxillo-maxillary suture with adjacent parts, for comparison with fig. 6. Ventral aspect. *One-half nat. size.*
- Fig. 8. *Hyla cærulea*. Mandibular symphysis, with related structures. Anterior aspect. *Three times nat. size.*

Reference Letters.

| | |
|---|---|
| <i>a.j.</i> Anterior orifice of Jacobson's organ. | <i>ns.</i> Septum nasi. |
| <i>ap.</i> Orifice of vomerine sac (? Jacobson's organ). | <i>ns.</i> Alary cartilage. |
| <i>c.s.</i> Naso-palatine (Stenson's) canal, cartilaginous wall of. | <i>ns.</i> Alary cartilage, internal, lamina of. |
| <i>fb.</i> Symphysial fibrous pad. | <i>ns.f.</i> Floor of cartilaginous olfactory capsule. |
| <i>f.p.</i> Premaxillary foramen. | <i>pl.</i> Palatine. |
| <i>f.pl.</i> Prepalatine foramen. | <i>pm.</i> Premaxilla. |
| <i>f.pl.</i> Postpalatine foramen. | <i>p.p.</i> Palatine process of premaxilla. |
| <i>fr.</i> Frontal. | <i>pt.</i> Pterygoid. |
| <i>jc.</i> Jacobson's cartilage. | <i>s.mp.</i> Maxillo-palatine suture. |
| <i>lg.</i> Vomerine ligament. | <i>sn.</i> Maxillary sinus. |
| <i>m.b.</i> Basi-mandibular cartilage. | <i>vo.</i> Body of vomer. |
| <i>m.m.</i> Mento-Meckelian bone. | <i>vo.</i> Wing of vomer (osseous floor of postnasal portion of olfactory chamber). |
| <i>mx.</i> Maxilla. | <i>vo.</i> Palatine lobe of vomer. |
| <i>na.</i> Nasal. | |
| <i>n.p.</i> Posterior nares. | |

2. On the Variation and Development of the Leporine Sternum. By R. H. BURNE, B.A. Oxon., F.Z.S.

[Received February 17, 1891.]

The mammalian sternum has been shown by Ruge¹ to be entirely costal in origin. The ventral ends of each pair of ribs come into apposition and subsequently fuse in the middle line to form, by ossification and segmentation, a sternebra; each sternebra is a product of the pair of ribs immediately behind it.

This holds good for the whole sternum, with the exception of its most anterior segment or manubrium: that, although in Man a product of the first two pairs of ribs, and therefore serially homologous with a couple of the sternebrae, is still further a compound structure, for Goette² has shown that it may embody (*Talpa*) the remnant of the episternum (interclavicle³) of the lower Vertebrata.

¹ "Untersuchg. ü. d. Entwickelungsvg. am Brustbein," Morph. Jahrbuch, pp. 373 *et seq.* (1880).

² Archiv f. Anat. u. Phys., Bd. xiv. p. 563 (1877).

³ Howes has recently suggested that this may be the vanishing vestige of a coracoidal archisternum of the Ichthyopsida ('Nature,' vol. xliii. p. 269, 1891).

Ruge has pointed out that the xiphisternum (processus ensiformis) of Man owes its origin to the eighth and ninth pairs of ribs; for he says, in the course of the paper above referred to, "das achte und neunte Rippenpaar vom Sternum sich loslösend ihre medialen Produkte noch im Processus ensiformis wiedererkennen lassen."

The Leporine sternum usually consists of four segments, exclusive of the omosternal and xiphisternal ones, and it therefore follows that that pair of ribs which stand related and give origin to the last prexiphisternal sternebra is the sixth pair; and as this is so the xiphisternum, on analogy to the human subject, might be expected to arise from the seventh and eighth ribs, one or both. The seventh pair of ribs ultimately break loose and approximate in the ventral middle line.

Not unfrequently, in both Rabbits and Hares, there is an extra sternebra intercalated behind the sixth (= fourth sternebra as ordinarily enumerated), and the occurrence of this structure (figs. A-F, p.161) has not previously been recorded.

This extra sternebra is invariably displaced dorsally; the lower ends of the seventh pair of ribs pass over its ventral surface and meet in the middle line, repeating as it were, in regard to it, those relationships which they more normally bear to the head of the xiphisternum.

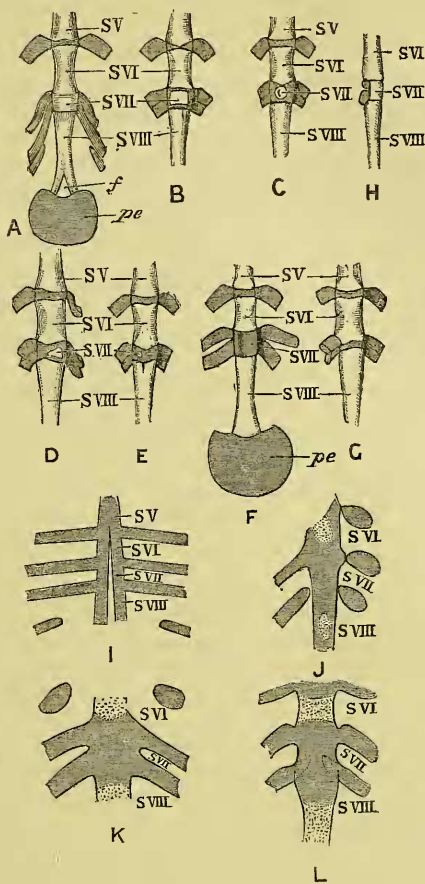
The sternebra in question always lies behind the sixth pair of ribs; these are attached to the synchondrosis between the sixth and the extra sternebra (VII), wherefore the latter would appear to be derived from the seventh pair of ribs.

This seventh sternebra is very variable in size, presumably as the result of variation in degree of absorption. It is probably not uncommon, for of thirteen fully ossified Leporine sterna, which I have examined, six possessed it in some form, and although in one case somewhat minute, it was yet distinctly recognizable.

Figs. A-G represent a series of fully formed sterna. In figs. A, B, C, D, E the extra sternebra (S. VII) will be seen to be represented more or less by bone; but in fig. F it is only present in cartilage, and in fig. G it is not present at all.

In rare cases the two portions of the primitive cartilages from which this sternebra is derived may be found still more or less united, a distinct groove being recognizable upon its dorsal surface (fig. F). I have found this to be so in animals possessed of an otherwise fully formed and ossified sternum. Be the individual conditions what they may, the seventh pair of ribs invariably meet in the ventral middle line, and are in no way attached at the sides of their intersternebra as are the ribs in front of them.

Turning now to the development of the seventh or "extra" sternebra. The earliest stage in its formation which I have observed was in an embryo Rabbit 3 cm. long. At this age (fig. I) the median cartilages of the sternum had only fused at their anterior ends; the first seven pairs of ribs were joined to them, but the rest floated free. The costal segments related to each pair of ribs had manifestly been formed each in the same way, the only



Series of sterna of *Lepus cuniculus* showing absorption of the seventh sternebra (dorsal aspect). Nat. size.

A, B, C, D, E show the seventh sternebra ossified; F, the seventh sternebra only represented in cartilage (the two halves had not as yet completely fused); G, normal sternum; H, side view of sternum, showing dorsal displacement of the seventh sternebra; I, sternum of embryo of 3 cm. total length; J, horizontal longitudinal section of sternum of embryo of 7 cm. total length; K, longitudinal section of sternum of embryo of 11 cm. total length; L, sternum of embryo of same age.

Reference letters: *f.*, fontanelle; *pe.*, ensiform process; S. V-VIII, sternebra.

apparent difference being that the seventh was smaller than the others. This seventh sternebra may thus be regarded as arising from the seventh pair of ribs, just as the other sternebrae do from the ribs in front, and as having a like morphological value with the former.

In the next stage (7 cm. long, fig. J, p. 161) the sternum had begun to ossify, centres of ossification being present in the xiphisternum and in all the sternebrae except the seventh; this structure, however, was still clearly present, although only represented in cartilage.

The seventh sternebra, in comparison with those remaining, is of the same size as in the previous stage. In sterna of this age the seventh pair of ribs have already begun to approximate ventrad of their sternebra, their lower extremities reaching nearly halfway to the middle line. Thus far the growth of the sternum has been regular and uniform, with the exception of the lack of ossification in the seventh sternebra; but about this time the sternebrae begin to grow unequally, and consequently to manifest slight differences in their proportions (figs. K, L). The gap between the sixth and seventh pairs of ribs is, at this stage, usually shorter than in the earlier ones; but occasionally these ribs are separated by a gap (fig. L), indicating that the seventh sternebra is still in process of growth. In none of these specimens was there, however, any sign of ossification in the seventh sternebra, although in all the other sternebrae it was much more pronounced than before.

The points of the seventh pair of ribs had in all cases approached much nearer the middle line than at the earlier stages.

In Rabbits just born (14–15 cm.) the most noticeable feature is the apposition of the lower extremities of the sixth and seventh pairs of ribs, the latter having by this time met in the middle line. None which I examined showed any trace of an ossific centre between the sixth sternebra and the xiphisternum.

It has been seen that in all 3 cm. embryos the seventh costal segment is formed from the seventh pair of ribs, in the same way as are the other costal segments from their respective ribs, and therefore it has morphologically the same value as each of those more normally present; it is, however, somewhat smaller than the other segments. We may therefore assume that in all cases the seventh sternebra is invariably present at an early age and that it differs only from its fellows in size.

All segments of the sternum appear now to grow uniformly; for in all 7 cm. embryos the seventh sternebra is relatively of the same size as in the previous stage; but it is still cartilaginous, all the others being now ossified. So far all the sterna of the same age are much alike; but in 11 cm. embryos the seventh sternebra is usually shorter in comparison with its fellows than in the earlier stages, although in some cases it is still of moderate size. Those in which it was short I take to be the more normal, the seventh sternebra having developed with the rest to a certain extent, and then, when the embryo was about 8 or 9 cm. long, having ceased to grow: the xiphisternum and sixth sternebra, as they increase in size, grow over

this minute half-developed cartilaginous seventh sternebra and, as it were, blot it out. Thus there would be left the more familiar form of sternum with no trace of anything between the sixth sternebra and the xiphisternum.

The following, as compared with the above, are the stages in metamorphosis of the permanently seven-segmented type. After the embryo has reached a length of 7-8 cm. the seventh sternebra, instead of ceasing to grow, as in the more familiar form, continues to do so for a longer or shorter time. The growth of this sternebra seems to stop at different ages in different individuals; at a somewhat later stage ossification sets in, more or less strongly, forming in some cases a large bone (fig. A), in others merely a minute nodule (fig. E); in others, again, ossification never occurs at all, and the sternebra persists as cartilage (fig. F).

From the foregoing it may be justly inferred that at some past date the Leporine sternum consisted of eight sternebrae (the xiphisternum being counted as one), and that afterwards, for some unknown reason, the seventh pair of ribs became detached and grew forward over the ventral surface¹.

The place of the seventh sternebra having been thus usurped by the ribs which gave rise to it, the latter (degradation following disuse) apparently began gradually to disappear, until there was realized the condition in which we now find it, *i. e.* that of maximum absorption.

These facts are not only interesting in themselves, but they throw light upon the origin of the xiphisternum. For if it be granted that each sternebra arises from the pair of ribs immediately behind it, the sixth sternebra would be the derivative of the sixth pair of ribs, the seventh when present of the seventh pair, and therefore the eighth (xiphisternum) of the eighth.

The Leporine xiphisternum would thus appear to be not (as the study of it in ordinary would suggest) different in origin from that of Man, but, on the contrary, homologous with it—at any rate as far as concerns its origin from the eighth pair of ribs. I have not been able to ascertain whether the ninth pair of ribs takes any part in its formation as it does in that of Man, but it seems not improbable that it may do so.

Another variation of some slight interest occurs in the xiphisternum: this structure is occasionally seen to be forked, a fontanelle being contained between the prongs (*cf.* fig. A). This split recalls in a minor degree the phenomenon of the "cleft sternum" well known to occasionally occur in the human subject². The groove in the seventh sternebra in fig. F is probably an example of the same failure to unite, but to a still less marked degree. Both these specimens will bear comparison with the Cetacean sternum,

¹ There seems to be an inclination on the part of all the ribs to do this, their articulation with the sternum being much more ventral than dorsal.

² *Cf.* Turner, "Description of a Cleft Sternum," *Journ. Anat. & Phys.* p. 103 (1879).

of which Parker¹ remarks: "There is an oval fontanelle (such as is common in Lizards) in the præsternum and a large part of the mesosternum, and the hinder part of the præsternum is occupied by the primordial fissure."

This inquiry has been carried out in the Biological Laboratory of the Royal College of Science, South Kensington, at the suggestion of my teacher, Prof. G. B. Howes; and to him my sincere thanks are due for his help and supervision.

The features noted apply equally to both the Rabbit (*Lepus cuniculus*) and Hare (*Lepus timidus*): no differences of fundamental importance being recognizable between them.

3. On the Muscicapine Genus *Chasiempis*, with a Description of a new Species. By SCOTT B. WILSON, F.Z.S.

[Received January 31, 1891.]

I propose in the present paper to state briefly the distinctions between the various species of this interesting genus of Flycatchers which are to be found inhabiting the various islands of the Hawaiian group, and this object will, I think, be greatly furthered by a key. In drawing this up, I have to some extent followed that given by my friend Dr. Stejneger (Proc. U. S. Nat. Mus. 1887, p. 87), and I should also mention here that, quite recently, I sent him a series of the different species in my collection, with the idea of ascertaining his opinion on some difficult points. Dr. Stejneger kindly answered me very fully, and I am glad to say that our views are nearly, if not quite, in accord on the subject.

Graf Hans von Berlepsch was kind enough to send me a short time since a paper of his on *Chasiempis*, containing a good coloured figure of one species. I do not agree with the conclusions at which he arrives, and think that they are partly due to the insufficient material he had to work upon; for, though the collection upon which he based his observations is rich enough as regards the number of specimens, but *one* island—Oahu—seems to be represented in it. I shall comment at length on this paper in the Part of my 'Birds of the Sandwich Islands' which deals with *Chasiempis*, merely stating here that Graf von Berlepsch unites *Chasiempis ridgwayi*, *Ch. ibidis*, *Ch. sclateri*, and *Ch. gayi* under the head of *Chasiempis sandwichensis*, and is of opinion that his series of skins bears this out. As will be seen further on, my views are very different from his, but are more probably correct, as I have had specimens from the different islands for comparison, while he had to rely in a great measure on figures and descriptions.

Another article which must be referred to is that by Dr. Sclater, "On the Muscicapine Genus *Chasiempis*" (Ibis, 1885, p. 17), a

¹ W. K. Parker, Ray Society's Monograph on the Shoulder-girdle and Sternum in Vertebrates, p. 217. Cf. also Flower, 'Osteology of Mammalia,' pp. 99, 100, figs. 37, 39.